

# PATENT COOPERATION TREATY RECEIVED

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**PCT**

<b>To:</b>  GRISWOLD, Joshua A. Fish & Richardson P.C. 5000 Bank One Center 1717 Main Street Dallas, TX 75201-4605 ETATS-UNIS D'AMERIQUE
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**NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL PRELIMINARY  
REPORT ON PATENTABILITY**  
(PCT Rule 71.1)

Date of mailing (day/month/year)	09.01.2006
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Applicant's or agent's file reference 17601-039WO1		<b>IMPORTANT NOTIFICATION</b>
International application No. PCT/US2004/036616	International filing date (day/month/year) 03.11.2004	Priority date (day/month/year) 17.11.2003
Applicant CDX GAS, LLC et al		

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary report on patentability and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

**4. REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary report on patentability. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed inventions is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer  Ter Haar, H  Tel. +31 70 340-3817
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# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 17601-039WO1	<b>FOR FURTHER ACTION</b>		See Form PCT/PEA416
International application No. PCT/US2004/036616	International filing date (day/month/year) 03.11.2004	Priority date (day/month/year) 17.11.2003	
International Patent Classification (IPC) or national classification and IPC E21B43/30, E21B43/00			
Applicant CDX GAS, LLC et al			
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 7 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>			
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input checked="" type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input checked="" type="checkbox"/> Box No. VIII Certain observations on the international application</p>			
Date of submission of the demand 14.09.2005		Date of completion of this report 09.01.2006	
Name and mailing address of the International preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016		Authorized Officer van Berlo, A Telephone No. +31 70 340-3535 	

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/US2004/036616

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**Box No. I Basis of the report**

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1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

**Description, Pages**

1-4, 9, 11-18	as originally filed
5-8, 10, 10a	filed with telefax on 14.09.2005

**Claims, Numbers**

1-9, 11-22	as originally filed
10	filed with telefax on 14.09.2005

**Drawings, Sheets**

18-88	as originally filed
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- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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**1. Statement**

Novelty (N)	Yes: Claims	
	No: Claims	1-22
Inventive step (IS)	Yes: Claims	
	No: Claims	1-22
Industrial applicability (IA)	Yes: Claims	1-22
	No: Claims	

**2. Citations and explanations (Rule 70.7):**

**see separate sheet**

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**Box No. VII Certain defects in the international application**

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The following defects in the form or contents of the international application have been noted:

**see separate sheet**

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**Box No. VIII Certain observations on the international application**

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The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
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(SEPARATE SHEET)**

International application No.

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**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Reference is made to the following document/s/:

D1: WO 03/036023 A (CDX GAS, L.L.C; ZUPANICK, JOSEPH, A; RIAL, MONTY, H) 1 May 2003 (2003-05-01)

2. The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1-22 is not new in the sense of Article 33(2) PCT.

2.1 The document D1 discloses, in particular in figures 5B and 6B and the passage cited in the search report (the references in parentheses applying to this document):

A well system, comprising;

a first well bore (vertical left side of 72, fig 5B) extending from a surface to a subterranean zone;

a second well bore (vertical right side of 72) extending from the surface to the subterranean zone;

a first articulated well bore (left horizontal part of 72) formed off of the first well bore, the first articulated well bore intersecting the second well bore and coupled to a first pattern formed in the subterranean zone through the first articulated well bore;

a second articulated well bore (38,70) formed off of the second well bore, the second articulated well bore intersecting the first well bore and coupled to a second pattern formed in the subterranean zone through the second articulated well bore;

the first pattern operable to transport fluids from the subterranean zone to the second well for production to the surface; and

the second pattern operable to transport fluids from the subterranean zone to the first well for production to the surface.

2.2 The same reasoning applies, mutatis mutandis, to the subject-matter of the corresponding independent claims 12, 18 and 21, which therefore are also considered not new.

2.3 The dependent claims do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and inventive step.

**INTERNATIONAL PRELIMINARY  
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(SEPARATE SHEET)**

International application No.

**PCT/US2004/036616**

• **Re Item VII**

- The independent claims are not in the two-part form in accordance with Rule 6.3(b) PCT.

- The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

**Re Item VIII**

- Although claims 1 and 12, and claims 18 and 21 have been drafted as separate independent claims in the same category, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT.

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and 32. An articulated well bore is any suitable bore extending from a well bore having a first orientation to another substantially disparate orientation or other suitable deviated well bore. To provide the curved portion with a radius of 100-800 feet (30-250 meters), the second well bore 32 may be offset a distance of about 300 to about 2000 feet (90-600 meters) from the first well bore 12. This spacing may reduce or minimizes the angle of the curved portion to reduce friction in each articulated well bore during drilling operations. As a result, reach of the drill string through the articulated well bores 40 is increased and/or maximized. In another embodiments, the second well bore 32 may be located otherwise at the surface with respect to the first well bore 12.

A first articulated well bore 40 is kicked-off the second well bore 32 above to cavity 34 and/or coal seam 15. A packer or plug 38 may be positioned in the second well bore 12 to prevent drilling fluid and debris from entering the cavity 34. In one embodiment, the first articulated well bore 40 is drilled using a drill string 50 that includes a suitable down-hole motor and bit 52. A measurement while drilling (MWD) device 54 may be included in the articulated drill string 50 for controlling the orientation and direction of the well bore drilled by the motor and bit 52. The articulated well bore 40 may be kicked off the second well bore 32 with a whipstock 42, other tool or drilling technique.

After the first cavity 20 of the first well bore 12 has been intersected by the first articulated well bore 40, drilling of the articulated well bore 40 is continued through the cavity 20 with drill string 50 to provide a first subterranean well bore pattern 60 in the coal seam 15 that is connected or otherwise coupled to the first well bore 12. In other embodiments, the first well bore 12 and/or cavity 20 may be otherwise positioned relative to the first well bore pattern 60. For example, in one embodiment, the first well bore 12 and cavity 20 may be positioned toward an end of the well bore pattern 60. Thus, the first well bore 12 and/or cavity 20 may be positioned within the pattern 60 at or between sets of laterals. Also, pattern 60 may be otherwise suitably formed or connected to the cavity 20. The first pattern 60 is in the coal seam 15 when a majority, substantially all or other substantial portion, is in the seam such that fluids may be transported from or to the seam by the pattern 60.

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The first well bore pattern 60 may be substantially horizontal corresponding to the geometric characteristics of the coal seam 15. The well bore pattern 60 may include sloped, undulating, or other inclinations of the coal seam 15 or other subterranean zone. During formation of the well bore pattern 60, gamma ray logging tools and conventional MWD devices may be employed to control and direct the orientation of the drill bit 52 to retain the well bore pattern 60 within the confines of the coal seam 15 and to provide substantially uniform coverage of a desired area within the coal seam 15.

In one embodiment, as described in more detail below, the drainage pattern 60 may be an omni-directional well bore pattern operable to intersect a substantial or other suitable number of fractures in the area of the coal seam 15 covered by the pattern 60. The drainage pattern 60 may intersect a significant number of fractures of the coal seam 15 when it intersects a majority of the fractures in the coverage area and plane of the pattern 60. In other embodiments, the drainage pattern 60 may intersect a minority percentage of the fractures or a super-majority percentage of the fractures in the coverage area and plane of the pattern 60. The coverage area may be the area between the well bores of the pattern 60.

The first subterranean pattern 60 may be a pinnate pattern, other suitable multi-lateral or multi-branching pattern, other pattern having a lateral or other network of bores or other patterns of one or more bores with a significant percentage of the total footage of the bores having disparate orientations. The percentage of the bores having disparate orientations is significant when twenty-five to seventy-five percent of the bores have an orientation at least twenty degrees offset from other bores of the pattern. In a particular embodiment, the well bores of the pattern 60 may have three or more main orientations each including at least 10 percent of the total length of the bores. For a pinnate pattern, the lateral bores may become successively shorter as the pattern progresses out from the cavity or well that is intersected. In addition, the distance from the intersected well bore to the distal end of each lateral through the lateral and main bore may be substantially equal.

During the process of drilling the well bore pattern 60, drilling fluid or "mud" may be pumped down the drill string 50 and circulated out of the drill string 50 in the

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vicinity of the bit 52, where it is used to scour the formation and to remove formation cuttings. The cuttings are then entrained in the drilling fluid which circulates up through the annulus between the drill string 50 and the walls of first articulated well bore 40 and the second well bore 32 until it reaches the surface 14, where the cuttings are removed from the drilling fluid and the fluid is then recirculated. To prevent over-  
5 balance drilling conditions during formation of the well bore pattern 60, air compressors 62 may be provided at the surface 14 to circulate compressed air down the first well bore 12 and back up through the first articulated well bore 40. The circulated air will admix with the drilling fluids in the annulus around the drill string  
10 50 and create bubbles throughout the column of drilling fluid. This has the effect of lightening the hydrostatic pressure of the drilling fluid and reducing the down-hole pressure sufficiently that drilling conditions do not become over-balanced. Aeration of the drilling fluid reduces down-hole pressure to less than the pressure of the hydrostatic column. For example, in some formations, down-hole pressure may be  
15 reduced to approximately 150-200 pounds per square inch (psi) (0-1.4 mega Pascal (MPa)). Accordingly, low pressure coal seams and other subterranean resources can be drilled without substantial loss of drilling fluid and contamination of the resource by the drilling fluid.

Foam, which may be compressed air mixed with water or other suitable fluid,  
20 may also be circulated down through the drill string 50 along with the drilling mud in order to aerate the drilling fluid in the annulus as the first articulated well bore 40 is being drilled and, if desired, as the well bore pattern 60 is being drilled. Drilling of the well bore pattern 60 with the use of an air hammer bit or an air-powered down-hole motor will also supply compressed air or foam to the drilling fluid. In this case,  
25 the compressed air or foam which is used to power the down-hole motor and bit 52 and exits the drill string 50 in the vicinity of the drill bit 52. However, the larger volume of air which can be circulated down the first well bore 12 permits greater aeration of the drilling fluid than generally is possible by air supplied through the drill string 50.

30 FIGURE 2 illustrates underbalanced formation of the first articulated well 40 in the well system 10 in accordance with another embodiment. In this embodiment,

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after intersection of the cavity 20 by the first articulated well bore 40, a Moineau or other suitable pump 64 is installed in the cavity 20 to pump drilling fluid and cuttings to the surface 14 through the first well bore 12. This eliminates or reduces both the head pressure and the friction of air and fluid returning up the first articulated well bore 40 and reduces down-hole pressure to nearly zero. Accordingly, coal seams 15 and other subterranean resources having ultra low pressures below 150 psi (1.0 MPa) can be accessed from the surface 14. Additionally, the risk of combining air and methane in the well may be eliminated or reduced.

FIGURE 3 illustrates formation of a second articulated well bore 80 in the well system 10. In the illustrated embodiment, the second articulated well 80 is formed off of the first well bore 12. Designation of first and second herein are provided for convenience to distinguish between elements of the same or similar type and do not necessarily designate order of formation or association between objects. Thus, for example, the second articulated well 80 may be formed immediately after the first well bore 12 is formed, and before formation of the second well bore 32 and the first articulated well 40. In such an embodiment, the second cavity 34 may be formed through the second articulated well 80 for intersection of the first well bore 32 or the second cavity 34 may be formed in the first well bore 32 to connect already drilled well bores 32 and 80. As previously described, the cavity may be omitted.

Referring to FIGURE 3, after formation of the first articulated well 40 and associated first subterranean pattern 60 are completed, the drilling rig may again be positioned over the first well bore 12 for formation of the second articulated well bore 80. A packer 38 may be placed in the first well bore 12 between the first cavity 20 and the kick-off point for the second articulated well 80 to prevent cuttings from settling in the cavity 20 and sump 22. A whipstock 42 may be used to kick-off the second articulated well 80.

The second articulated well 80 may be substantially similar to the first articulated well 40 and include a curved or radiused portion and a substantially horizontal portion. The substantially horizontal portion, in one embodiment, intersects the second cavity 34 of the second well bore 32. As described in connection with a first articulated well bore 40, the substantially horizontal portion of

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disorbed from coal in the seam 15 and produced to the surface 14 is collected at the well head and after fluid separation may be flared, stored or fed into a pipeline.

Referring to FIGURE 4A, after the first and second well bores 12 and 32, and the first and second well bore pattern 60 and 90 have been drilled, a tubing string 100  
5 may be disposed in each well bore 12 and 32 with a port 102 positioned in the corresponding cavity 20 and 34. Each cavity 20 and 34 provides a reservoir for water or other fluids collected through the corresponding drainage pattern 60 and 90 from the coal seam 15. In one embodiment, the tubing string 100 may be a casing string for a rod pump to be installed after the completion of gas lift and the port 102 may be  
10 the intake port for the rod pump. In this embodiment, the tubing may be, for example, a 2 7/8 inch (7.3 cm) tubing used for a rod pump. It will be understood that other suitable types of tubing operable to carry air or other gases or materials suitable for gas lift may be used.

At the surface 14, one or more air compressors 104 are connected to each  
15 tubing string 100. Air compressed by the compressors 104 is pumped down each tubing string 100 and exits into the corresponding cavity 20 and 34 at the port 102. The air used for gas lift and/or for the previously described under balanced drilling may be ambient air at the site or may be or include any other suitable gas. For example, produced gas may be returned to the cavity and used for gas lift. In the  
20 cavities 20 and 34, the compressed air expands and suspends liquid droplets within its volume and lifts them to the surface. In one embodiment, for shallow coal beds 15 at or around one thousand feet, air may be compressed to three hundred to three hundred fifty psi (2.1-2.4 MPa) and provided at a rate of nine hundred cubic feet per minute (CFM) (25.5 cubic meters/minute). At this rate and pressure, the gas lift system may  
25 lift up to three thousand, four thousand or five thousand barrels a day of water to the surface.

At the surface, air and fluids from each well bore 12 and 32 are fed into a fluid separator 106. Produced gas and lift air may be outlet at air/gas ports 108 and flared while remaining fluids are outlet at fluid ports 110 for transport or other removal,  
30 reinjection or surface runoff. It will be understood that water may be otherwise

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suitably removed from the cavities 20 and 34 and/or patterns 60 and 90 without production to the surface 14. For example, the water may be reinjected into an

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AMENDED SHEET

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7. The well system of Claim 1, wherein the subterranean zone comprises a coal seam.
8. The well system of Claim 7, when the fluids comprise water and coal bed methane (CBM) gas.
- 5 9. The well system of Claim 1, further comprising:  
the first articulated well bore including a packer disposed between the first well bore and intersection of the second well bore;  
a second articulated well bore including a packer disposed between a second well bore and intersection of the first well bore.
- 10 10. The well system of Claim 1, wherein the first and second pattern together comprise a coverage area in the subterranean zone of at least 600 acres (243 hectares).
11. The well system of Claim 3, wherein a lateral of the first pattern extends from the main substantially horizontal well bore prior to intersection with the  
15 second well bore and a lateral of the second pattern extends from the main substantially horizontal well bore prior to intersection with the first well bore.
12. A well system, comprising:  
at least two well bores extending from a surface to a subterranean zone;  
each of the two well bores being used to form a substantially horizontal well  
20 bore pattern for the subterranean zone that intersects the other well bore and transports fluid from the subterranean zone to the other well bore for production to the surface; and  
each of the two well bores operable to collect for production to the surface fluids transported to the well bore by the substantially horizontal well bore pattern  
25 formed through the other well bore.
13. The well system of Claim 12 wherein the substantially horizontal well bore patterns each comprise a main well bore and a plurality of lateral well bores extending from the main well bore.
14. The well system of Claim 12, wherein the substantially horizontal well  
30 bore patterns each comprise a pinnate pattern.

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